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PALOS HILLS AREA

GEOLOGICAL SCIENCE FIELD TRIP

November 12, 1971

Cook and Du Page Counties
Palos Park and Sag Bridge
7.5-Minute Quadrangles

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PALOS HILLS GEOLOGICAL SCIENCE FIELD TRIP

ITINERARY

Line up on West 97th Street at Roberts Road, opposite H. H. Conrady Junior High School, heading west.

0.0 0.0 Turn right (north) on Roberts Road (80th Avenue).

We are driving along the Tinley Moraine, a wide belt of gravel and earth ridges that form the higher hills in the Hickory Hills Golf Course west of the road. This belt of ridges is as much as 6 miles wide, and it extends roughly parallel to Lake Michigan and almost continuously from Wisconsin to Indiana. The Tinley Moraine was deposited about 14,000 years ago by a glacier flowing from Canada into Illinois through the trough that now contains Lake Michigan.

As the glacier melted, water was trapped between the Tinley Moraine and the ice front. As the ice front melted back into the Lake Michigan basin, a large lake came into being, covering all the land east of the Tinley Moraine. The place covered by the glacial lake--the area that was the lake bed--is called the Chicago Lake Plain. The Chicago Lake Plain is an extremely flat region about 45 miles long and 15 miles wide, bounded on the west by the Tinley Moraine and containing the city of Chicago and many of its suburbs (see figure 1).

The lake that formed between the Tinley Moraine and the glacier is called Lake Chicago, and it lasted almost 4,000 years (from about 14,000 years up to about 10,500 years before present) at levels fluctuating between approximately 640 feet and 590 feet MSL (feet above mean sea level). Now the approximate mean level of Lake Michigan is 580 feet, and the Sag Channel stands at the level of the lake.

The flatness of the lake plain would make it possible for a lake level only 15 to 20 feet higher than the present one to flood much of the Chicago Lake Plain. Lake Chicago's highest and earliest level--the Glenwood stage--was at about 640 feet MSL. At this level, about 14,000 years ago, the lake stood about 20 feet up on the hill slope in the golf course (the lower ridge or terrace). The parking lot at H. H. Conrady School would be about 30 feet underwater in a lake standing that high.

The flatness of this lake plain is largely a consequence of the size and depth of the lake that covered it. Lake Chicago in all its stages was a wide, shallow lake. Winds blowing over its broad surface continually made waves that planed its shores and shoaly parts. Winds and waves created currents that moved sediments to fill in and level the lake floor. Then, too, the lake was contained by a blanket of glacial drift, and this clay-silt-sand-gravel mixture was readily washed apart and distributed. Only a few low landforms rise above the lake plain. There are a number of sand ridges--less than 10 feet high--that were spits and bars in the lake. Stony Island and Blue Island were islands in the lake.

0.25 0.25 Stoplight. Turn left (west) onto West 95th Street.

0.15 0.4 Ascend the Tinley Moraine.

0.85 1.25 Stoplight. Turn right (north) on 88th Avenue. The hilly, hummocky topography is typical of an end moraine.

0.5 1.75 T-road from right. Turn right (east) on West 91st Street.

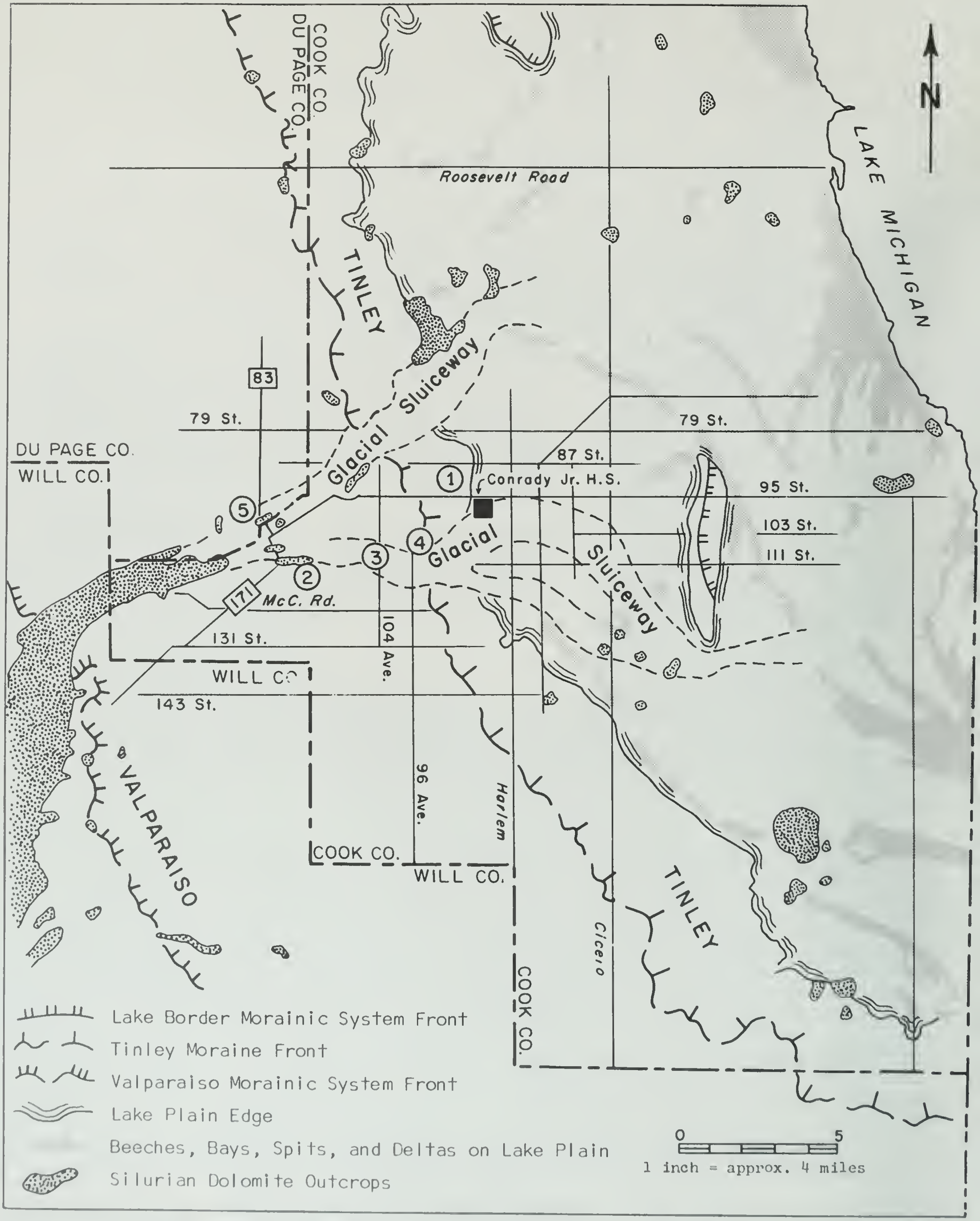


Fig. 1 - Surface geology of southwestern Chicago area.

0.1 1.85 Excellent view towards the northeast out across the lake plain.

0.15 2.00 Turn left (north) on 86th Avenue.

0.15 2.15 Turn left at south driveway entrance to St. Patricia's School.

0.05 2.2 Stop 1. An overview of the Chicago Lake Plain and a soil and weathered till exposure at St. Patricia's School. (NE¼ SW¼ NW¼, Sec. 2, T. 37 N., R. 12 E., Cook County.)

At this place we are standing on the Tinley Glacier's end moraine, about 75 feet above the lake plain. Because of the flatness of the lake plain, this relatively slight elevation is enough to provide a view of the Loop about 15 miles away--providing the weather is clear.

The Parent Soil Materials. Excavation of the school yard left a cutbank south of the school which exposes about 5 feet of ice-deposited drift--or till--covered by a foot of wind-deposited silt called loess. The till was deposited by the Tinley Glacier about 14,000 years ago. After the glacier melted back, winter winds swept the dust from the floodplains in front of the glacier and deposited it here as loess. (In the winter the glacier stopped melting, and its meltwater streams stopped flowing. As their wide, bare floodplains dried, great quantities of "rock flour" pulverized by the glacier could be blown about by the wind.)

Loess is an excellent parent material for soil, and the extraordinary fertility of many Illinois farm lands is partly due to the loess deposits that cover the state. The thin loess in this exposure is typical in this region, but in the western half of the state along the Illinois and Mississippi Rivers loess thicknesses range from 4 feet to more than 25 feet.

The textures of the loess and till are quite different. Note the level to which the path along the brow of the slope is worn and the different slopes which are formed by the two materials. The loess is friable (crumbles easily), and foot traffic easily wears it away. In contrast the till is clayey and tough; it "supports" the path and maintains a lower slope than the loess.

The Effects of Weathering. As soon as the loess and till were deposited and exposed to the weather, air and water and living things began to infiltrate and alter them. Some of the changes brought about by these agents are obvious and some are subtle or hidden, but all have combined to produce the weathering profile we see in these sediments.

Colors. The color bands across weathering profiles--and, in fact, the colors of most rock and earth--are chiefly tinted by iron oxides. The amount of iron oxide and the kind--there are "red-rust" and "gray" oxides--determine whether the rock color will be ocherous (tan, yellow, brown, red) or a tone of gray (green, gray, or black).

The surface soil layer or A-zone (see figure 2) owes its color to the loss of iron, which has been dissolved and leached out by water, and to the addition of some organic matter. Much organic matter darkens a soil, but soils like the one here, developed on uplands under timber, are light-colored because the vegetation that falls on them is largely consumed above ground by small organisms before it is mixed in the soil. In contrast, soils developed in wet, poorly drained lowlands under grass--or low annual vegetation--are typically black because water inhibits

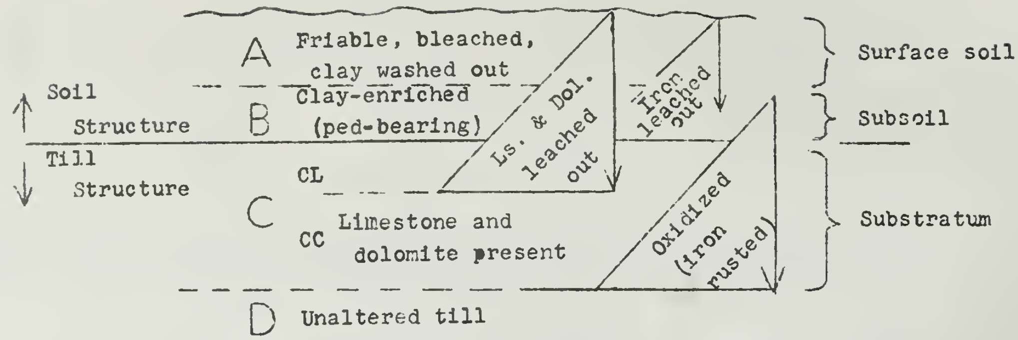


Fig. 2a - Mature, ideally developed weathering profile.

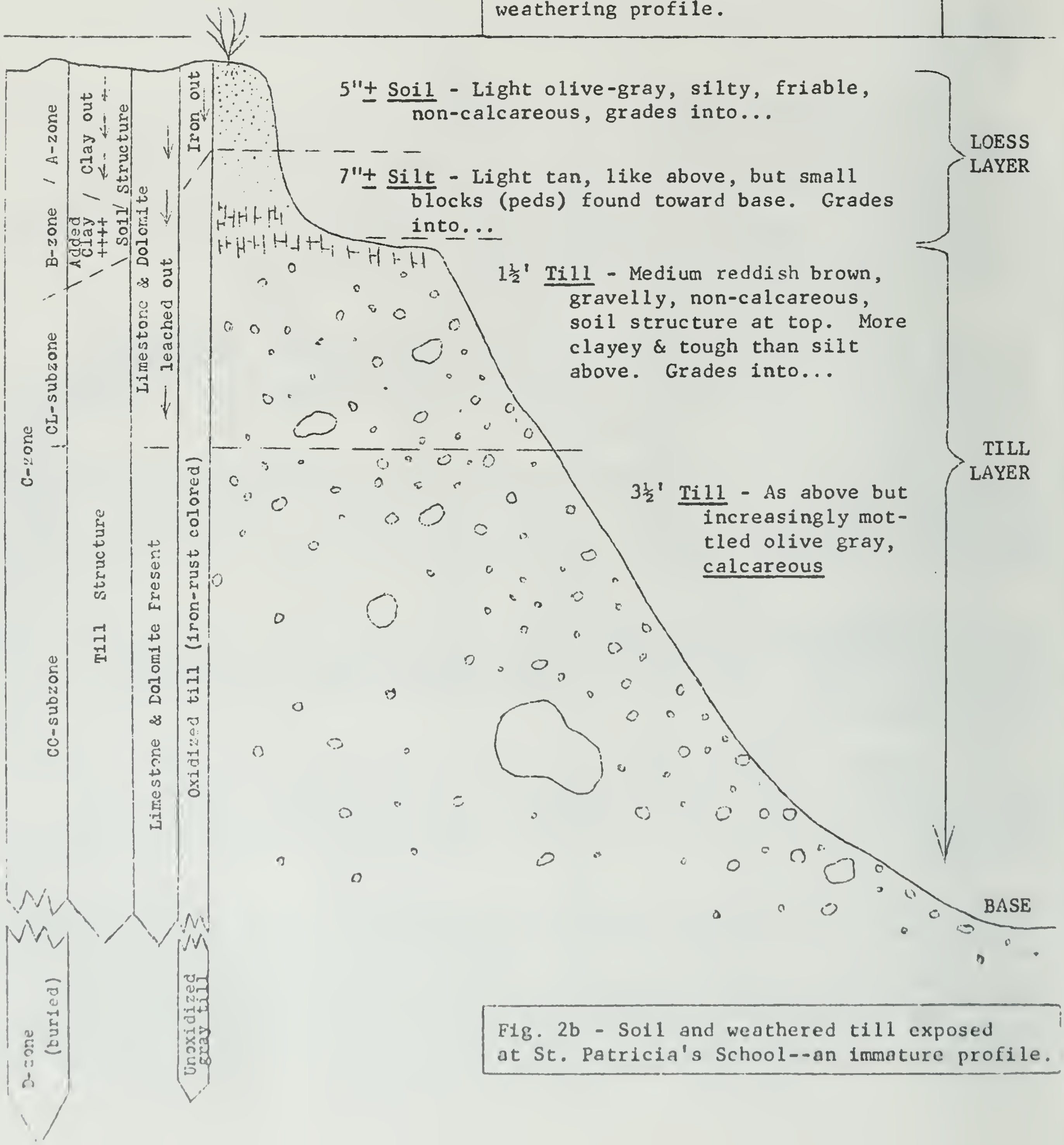


Fig. 2b - Soil and weathered till exposed at St. Patricia's School--an immature profile.

the activities of the organisms that would consume the vegetative mat. The black muck and peat deposits in swampy places in this region are extreme examples of this type of soil development.

The light tan layer under the surface soil is probably almost the original color of the loess. The cut does not go deep enough to expose the color of gray, unweathered till. The iron minerals in the till section have been oxidized reddish-brown, but in the lower part of the section--in the CC-zone--the olive gray mottling is probably near the original color of the till. The D-zone in a weathering profile --the zone of unaltered parent material--begins where the color of the iron minerals in the parent material changes completely from ocherous "rust" colors to gray tones.

Carbonate Leaching. Other qualities of the weathering zones in this cut are not so obvious. If dilute hydrochloric acid (10% solution) is dripped down the whole slope, very active fizzing and frothing can be observed on the lower 3½ feet. In this part, the acid is reacting with fine particles of limestone and dolomite--the acid causes these carbonate minerals to release carbon-dioxide gas. The acid test has demonstrated that the limestone and dolomite are present in the lower section and that the minerals have been dissolved and leached out of the upper part. The upper part of the soil is no longer "calcareous," even though pebbles of limestone and dolomite can be found in it. Considering the abundance of dolomite pebble and cobbles in the drift, it is not surprising that perhaps as much as 70% of the drift is made up of limestone and dolomite. The loss of this much material from the upper part of a section causes shrinkage and visible changes in the color, texture, and surface response to weather. For example, color mottling in this section seems to begin in the calcareous layer, the CC-zone.

The Movement of Clays. This weathering profile does not have a well-developed subsoil (B-zone), so it is necessary to look closely to find the evidence of another alteration weathering has made in the parent materials: the rinsing of clays down from the surface soil into the subsoil.

In the upper zones of the parent material, the effects of weather--freezing and thawing, drying and wetting--crack the upper layer of parent material, and roots and burrowing creatures make holes in it. As a consequence of these disruptions, the parent material becomes more porous, and water and air move through it more readily. Leaching and oxidation are results already discussed. But in addition, water percolating down through the soil washes the smallest soil particles, the clays, down holes and cracks.

Because clays are washed out of it, the A-zone becomes increasingly friable, while the B-zone receiving the clays becomes more clayey and tough. The structure of the B-zone also changes because the blocks and prisms of soil formed by the intersection of cracks are held together by the skins of clay that are deposited on their sides. These clay-coated blocks and prisms are called peds, and in this section they seem to be developed in a narrow zone at the contact of the loess and the till.

The B-zone is not well developed in this section, and the A-zone and B-zone are thin and apparently confined to the loess mantle on the till. For these reasons, the section is said to have an "immature" weathering profile. In an older "mature" profile, the zones would usually be wider, more distinct, and more deeply developed.

Other Effects. Many weathering processes are invisible, and soil parent material has many more constituents than we can deal with in this discussion.

However, some effects of weathering on rocks and minerals in the parent material can be noted. Examine the rocks exposed on the section and the several large boulders nearby. (Note that the graded area southeast of us is covered with transported fill, and do not be confused by thinking it is in place here.)

Shales and other "weak" rocks are split and crumbled by freezing and thawing, wetting and drying. Some of the minerals exposed in weathered igneous rocks are changed: the black and green minerals, which contain iron, are "rusted." Layered minerals--the micas--"rust" and swell and flake apart. The pink and white marble-colored feldspars lose their luster and, if weathered enough, partly turn to clay that dusts crystal faces and fracture surfaces. Some rocks are so weathered --their once close-knit minerals so swollen and weakened--that they crumble in your hands. Others have weathering rinds--layers of minerals that have swollen until they can be knocked off the rock as shells.

Note: The Tinley drift contains fragments of tan and dark gray Devonian shale. Very commonly, the shale contains a fossil plant spore called Sporangites. The spores appear to the naked eye as barely visible reddish brown specks.

0.0 2.2 Leave Stop 1.

0.05 2.25 Turn left (north) on 86th Avenue.

0.1 2.35 Stop. Turn left (west) on 89th Street.

0.2 2.55 Turn right (north) onto Pleasant Avenue. Follow the curving drive.

0.1 2.65 Turn right (east) on Lynwood Drive.

Behind the houses to the right is a shallow draw separating them from the houses on the next street to the south (Hillside Drive). The houses along the south side of the draw are situated on a low, narrow, sinuous ridge that extends intermittently east-northeast for about 0.6 mile. This ridge is an esker, a ridge of sand and gravel draped over the irregular backslope of the underlying Tinley end moraine. The esker is the sand-and-gravel filling of the bed of a meltwater stream flowing in a cave beneath the ice or in a crevasse (crack or open joint) near the ice margin (front). The shape of the esker has been changed somewhat because of construction in the area.

0.15 2.8 T-road intersection. Turn hard right (south-southwest) on Hillside Drive.

Note the large boulders scattered along the curb and throughout some of the home landscapings. These rocks have been procured from the glacial drift in this area and are called glacial erratics because they are foreign to the area and unlike the dolomite boulders derived from local bedrock. These erratics are igneous and metamorphic rock types that crop out in the northern United States and Canada.

0.05 2.85 Ascend the esker to the south and southwest. Although the general elevation of this feature probably has not been changed too much, construction of streets and homes has made it difficult to trace the extent of the esker throughout the subdivision.

0.15 3.0 STOP. T-road intersection. Turn right (west) on 89th Street. The area immediately to the left posted with "No Dumping Allowed" signs presents an idea of the tremendous amount of man-made change that can take place over a fairly large area in a comparatively short time. Note the great amount of rubble and excavation materials that have been dumped here.

0.15	3.15	STOP. Turn right (north) on 88th Avenue.
0.15	3.3	Tinley Drift exposed on the right in the ditch and the roadcut.

To illustrate the rich collecting possibilities of late Wisconsinan drift in this area, it should be pointed out that in less than half an hour a rock collection was made from this ditch and roadcut. The collection included four different fossils, four igneous rock types, all sedimentary rock types, several metamorphic rock types, and a number of specimens illustrating the effects of ice and water abrasion.

0.1	3.4	STOP. 4-way stop. Note the cutbank in Tinley Drift on the northwest corner of the intersection. Turn right (east) on 87th Street.
0.2	3.6	Descend back slope of the Tinley Moraine.
0.3	3.9	Notice the grassy, swampy area to the left. It is very typical of this part of Chicago.
0.5	4.4	STOP. 4-way stop. Turn right (south) on Roberts Road (80th Avenue).
1.0	5.4	CAUTION. Stoplight. Intersection with 95th Street. Continue south on Roberts Road.
0.7	6.1	Note very low areas within the lake plain in this vicinity.
0.3	6.4	STOP. Intersection with 103rd Street. Turn left (east) on 103rd Stree
0.5	6.9	Notice the large boulders and the low lying area to the left, which is part of the glacial sluiceway.
0.5	7.4	CAUTION. Stoplight. Turn right (south) on Harlem Avenue. Ahead, to the south, notice the gentle rise up toward Worth.
0.3	7.7	Enter Worth and cross Stony Creek, which occupies one of the Lake Chicago sluiceways.
0.1	7.8	CAUTION. Stoplight. Intersection with Southwest Highway (Illinois Route 7). Continue ahead (south) on Harlem Avenue. Notice that this is an area of fairly low relief since it was once part of the lake bottom.
0.6	8.4	CAUTION. Stoplight. Intersection with 111th Street. Continue ahead (south) and ascend the higher portion of Worth Island. This area, just barely above 625 feet, is just above the level of the Calumet lake stage (620'). See figure 1.
0.3	8.7	Descend the south side of Worth Island. Beyond the channel and bridge are beach ridges of approximately the same elevation as here.
0.2	8.9	CAUTION. Stoplight. 115th Street. Continue south on Harlem Avenue.

0.3	9.2	Cross the Calumet Sag Channel bridge.
0.2	9.4	CAUTION. Stoplight. Intersection of Illinois Routes 43 and 83. Turn right (west) on Illinois 83.
0.9	10.3	Wabash Railroad underpass. Continue ahead.
0.1	10.4	CAUTION. Stoplight. Intersection Southwest Highway (Route 7). Continue west on Illinois 83 and curve to the right.
0.6	11.0	Note the spoil banks heaped up on the right along the Cal-Sag Channel. These have a great deal of dolomite in them and might prove to be fruitful places to look for fossils.
0.4	11.4	T-road intersection from left, 86th Avenue. Continue west skirting the Tinley Moraine just to the left.
0.75	12.15	T-road from left. Kean Avenue. Continue ahead (west).
0.4	12.55	CAUTION. Cloverleaf intersection with U.S. 45. Continue west on Illinois 83.
0.4	12.95	T-road from left. Swallow Cliff toboggan slide. Continue west.
0.65	13.6	Intersection with 104th Avenue. Continue west.
1.0	14.6	Beyond the spoil piles on the right is Mt. Forest Island on the other side of the Cal-Sag Channel. That area at one time had Lake Chicago on the east and outlet rivers on the northwest and south.
0.3	14.9	Notice the low, swampy, grass-filled area to the right, below the road.
0.7	15.6	Truck entrance to quarry from right. Continue ahead west.
0.2	15.8	Park on wide right road shoulder just across from private entrance road on the left side of the highway.

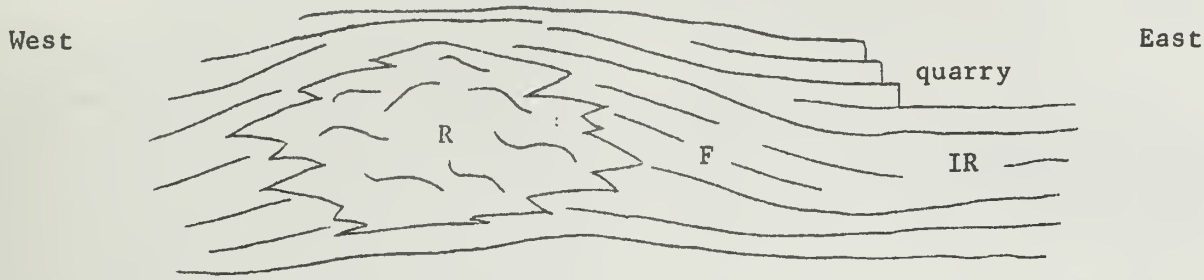
Stop 2. An abandoned dolomite quarry--a walk on the bottom of an ancient sea. (SW¼ SE¼ SE¼, Sec. 13, T. 37 N., R. 11 E., Du Page County.)

This quarry is developed in beds of Racine Dolomite, a formation in the upper part of the Silurian System. Silurian dolomite is the only bedrock exposed in our study area. The largest outcrops occur to the west in the Des Plaines river valley, but large quarries also operate east of here.

Late in Silurian time, about 400 million years ago, the quarry floor was a level sea bottom composed of mud, limy ooze, and shell debris. About half a mile west of here, the sea floor sloped up gently to the base of a reef. The reef was probably at least several hundred yards in diameter, oval, and high enough, perhaps, to break the water's surface. Like reefs today, it was built by coral animals and sheltered many other sea animals we know--sponges, bivalves, and snails Seeing the reef and the ocean floor, we would have felt it looked familiar. Some of the crawling things--the strange primitive fishes and the large squid-like creatures with the long, straight cone shells--might have startled us, however. There were many reefs like this one in the ancient Silurian seas which covered the mid-continent.

In the ages that passed, the reef and the layers of muddy, shelly ooze were buried by hundreds of feet of sediment and became limestone. At some time, by a process not well understood, the calcium of the limestone was replaced by magnesium and the limestone became dolomite. Uplift above sea level and millions of years of erosion exposed the dolomite beds along this valley where they were discovered and quarried.

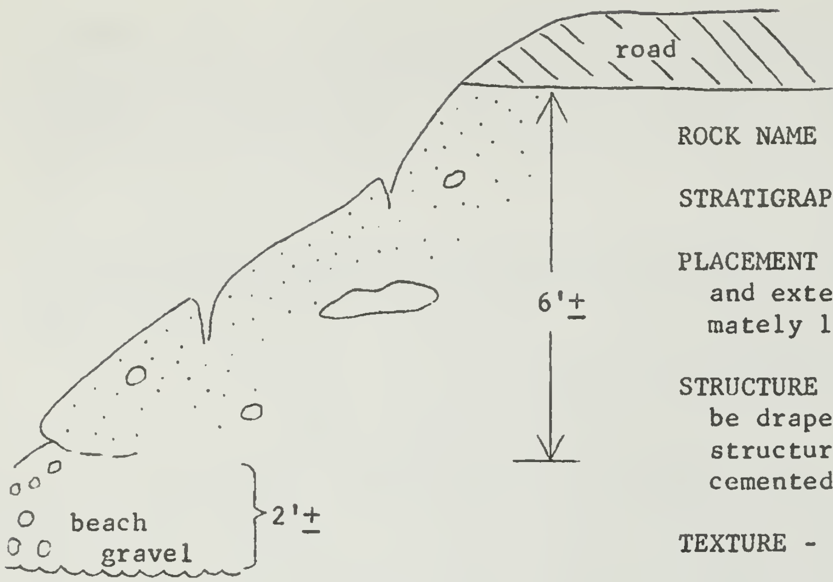
Today the quarry exposes thin, very even, nearly horizontal beds of dolomite. A half-mile to the west, south of 111th Street, a small creek valley cuts into the reef itself. North of the reef, where the creek crosses 111th Street, the steeply dipping flank beds are exposed.



This cross-section shows the relation of the massive (mainly unbedded) reef rock, "R"; the dipping reef flank beds, "F"; and the near-horizontal interreef (between-reef) beds, "IR," which are exposed in the quarry.

Even though a host of animals lived in the Silurian seas, relatively few well-preserved fossils are found in this region. When the limestones were changed to dolomite, fossil structures were partly or wholly obliterated. The half-molds of the large straight-cone cephalopods are preserved on the upper level of the west side of the quarry. Porous rock fragments commonly contain the molds of small shells. A fossil plate in the appendix shows some typical Silurian fossils as they are found in another part of the state.

0.7	16.5	CAUTION. Stoplight. Sag Bridge village. Intersection with Illinois 171. Turn right (north) on 83 and 171.
0.2	16.7	A number of abandoned dolomite quarries lie to the right and left. The stone has been used for rip-rap and for building stone--the seawalls along Lake Michigan are constructed of it. In places, particularly southwest of here in the vicinity of Lemont, the Sag Channel and the Chicago Sanitary and Ship Canal are excavated through dolomite.
0.55	17.25	Cross Calumet Sag Channel bridge.
0.1	17.35	CAUTION. Stoplight. Turn right (east) on 107th Street.
1.6	18.95	Note Saganashkee Slough to the right. It is a very low-lying area in the southern glacial sluiceway and has muck and peat in it. Notice how dark the mucky soil is around the edge of the water. The Valparaiso Morainic System lies to the west on the south side of the channel.
1.6	20.55	STOP - 4-way. 104th Avenue. Turn right (south) on 104th Avenue.
0.25	20.8	Stop 3. Section "X"--outcrop on west side of road. (East edge SE¼ NE¼ SE¼, Sec. 17, T. 37 N., R. 12 E., Cook County.)



ROCK NAME - ____________________

STRATIGRAPHIC POSITION - ____________

PLACEMENT - outcrop is on west side of road and extends parallel to the road approximately 100 yards.

STRUCTURE - 6'± thick, massive, appears to be draped on slope, may have some flow structure, very friable and weakly cemented.

TEXTURE - conglomeratic.

COMPOSITION - calcareous cement, largely quartz sand with small rusted iron inclusions and fragments of coaly and bituminous material.

COLOR - very light gray (fresh surface) and yellowish gray (weathered).

Identifying this rock and discovering the agent that deposited it will exercise your geological skills.

What does the shape of the deposit tell about its origin?
Is the material glacial till?
Is this rock like the bedrock we have seen elsewhere on the trip?
Have you seen anything like it before?
What does the rock contain that indicates the agent that deposited it?
(Explanation on last page.)

On the right is a spoil pile that was dumped on peat. The peat is incompetent and unstable, so that the great amount of spoil has overloaded it and caused the underlying peat to flow outward and produce gentle land swells on the east side of 104th Avenue.

0.25	21.05	Turn around and return (north) to 107th Street. Turn right and continue east on 107th Street.
1.0	22.05	CAUTION. STOPLIGHT. Turn right (south) on La Grange Road (U.S. Route 45).
0.05	22.1	Note large sanitary landfill site to the left in a former sand and gravel pit.
0.45	22.55	CAUTION. Stoplight. Turn left (east) onto 111th Street.
0.5	23.05	Crossroads. Turn left (north) on Kean Avenue.
0.1	23.15	Proceed across lake plain. Notice terrace level in the foreground--

the "step" in the slope--from the left to the right. This is the equivalent of the Calumet Terrace level which was cut by Lake Chicago when it stood at an elevation of 620 feet.

0.2 23.35 Coming up on the Calumet terrace level.

0.2 23.55 Crossroads. Intersection 107th Street. Turn left (west) on 107th and ascend hill.

0.1 23.65 Turn left into the parking lot at church.

0.05 23.7 Stop 4. View across the head of the Chicago Outlet River. (NE¼ NE¼ SW¼, Sec. 15, T. 37 N., R. 12 E., Cook County.)

At this point study figure 1 and locate the town of Worth and the Sag Channel. Look to the south and locate a wide, flat-bottomed notch. The Tinley Moraine comes to the left side of it, and the Valparaiso Morainic System is the land surface on the right. At our feet is the valley that intermittently carried the overflow from Lake Chicago for a period of about 4,000 years.

From the time of the Tinley glaciation until about 11,000 years ago, meltwater from glaciers flowing into the basin now occupied by Lake Michigan flowed through the Valparaiso and Tinley Moraines in the Chicago Outlet River.

The head of the Chicago Outlet River (see figure 1) was formed by the two glacial sluiceways--the Des Plaines Channel (to the north) and the Sag Channel. Near the village of Sag Bridge the sluiceways merged and the Chicago Outlet River occupied what is now the Des Plaines River Valley to the southwest.

As the glaciers that came after the Tinley glacier flowed over the north end of Lake Michigan and Lake Huron, they blocked eastward drainage through the lake basins, and their meltwaters were impounded until their level rose high enough to flow through the Chicago Outlet River. As time passed, the water cut the outlet lower, and the lake levels after the 640-foot Glenwood level fell to 620 feet (the Calumet stage) and 600 feet (the Toleston). These different stages are marked by wave-cut terraces, beaches, and other shore features at these elevations.

0.05 23.75 Leave church parking lot. Turn right (east) on 107th Street.

0.1 23.85 STOP. Kean Avenue. Moraine Valley College to the right in the distance. Turn left (north).

0.1 23.95 Notice the indiscriminant dumping of trash on the right side (east) of the road.

0.3 24.25 Notice the difference in elevation of the topography to the left and to the right. To the left are very gently rolling, rather swampy tracts developed on the backslope of the Valparaiso Morainic System. To the right is a much more sharply rolling higher topography, developed on the Tinley Moraine.

0.1 24.35 T-road intersection from right--103rd Street. Continue north on Kean Avenue.

0.45 24.8 T-road from right. Windsor Drive. Continue north on Kean Avenue.

Several homes are built on high terraces that have been produced by filling in along the front of the moraine. Fill material may be relatively unstable. If the fill is not properly selected and compacted, especially considering the amount and steepness of slope involved, problems could develop--cracks and displacement of sidewalks, driveways, foundation walls, etc. Watering the grass and shrubs, and freezing and thawing, may also slicken the fill material so that it slides very easily--sags or scars may develop along the slopes and trees and shrubs may move downslope. Observation of this site over a period of years should prove enlightening as to the relative speed with which some geologic processes occur. Some trees eventually may have arched or bowed trunks, etc. Notice part of this fill is on peaty muck at the bottom, which is also unstable. To the left (west), just across Kean Avenue, is a lake (Belly Deep Slough) that is formed in a peat deposit.

0.35	25.15	The field to the right indicates pre-fill conditions, but northward there has been a lot of dumping in it.
0.2	25.35	STOP. Intersection West 95th Street. Turn left (west) on 95th Street (Routes 12 and 20).
0.15	25.5	Notice the swampy areas and small lakes on either side of 95th Street that have formed on the Valparaiso ground moraine at the toe of the Tinley Moraine.
0.1	25.6	CAUTION. Stoplight. Intersection La Grange Road (U.S. Route 45). Continue west on 95th Street.
0.1	25.7	Note large ponds, swamp areas on both sides of 95th Street.
1.15	26.85	STOP (4-way). 104th Avenue. The Little Red School, Cook County Forest Preserve conservation teaching center, is located approximately 0.6 mile south of this intersection on 104th. A number of exhibits are on display for the public. CONTINUE WEST ON 95th STREET.
0.6	27.45	Maple Lake to the left. This is a Pleistocene kettle lake that was naturally drained by headward erosion of two streams. The forest preserve district dammed the two outlets (95th Street crosses these dams) in order to reflood the area.
0.4	27.85	Y-intersection. Bear right.
0.15	28.0	Y-intersection. Bear left.
0.1	28.1	STOP. Continue left (southwest) on Illinois 171. Since leaving Roberts Road (80th Avenue), the itinerary has been across Mt. Forest Island, a triangular-shaped landmass that during late Wisconsinan time was isolated by glacial Lake Chicago on the east and the confluence of the Lake Chicago outlets on the south and northwest. The itinerary now is along the southeast side of the northwestern sluiceway that intermittently carried overflow from Lake Chicago.
2.3	30.4	CAUTION. Stoplight at the junction with Route 83. Turn right on Route 83. Cross Gulf, Mobile, and Ohio Railroad, the Illinois and Michigan Canal, the Chicago Sanitary and Ship Canal, the Des Plaines River, and the Santa Fe Railroad. Ascend hill and prepare to turn left on Bluff Road.

0.9 31.3 CAUTION. Stoplight. Bluff Road. Turn left (west).

0.85 32.15 CAUTION. HAZARDOUS INTERSECTION. Cass Avenue. Bear left.

0.15 32.3 T-road from left. Turn left and enter Rocky Glen Forest Preserve, Du Page County.

0.05 32.35 Parking lot.

Stop 5. Silurian bedrock and Wisconsinan glacial features. (SE¼ NE¼ SW¼, Sec. 10, T. 37 N., R. 11 E., Du Page County.)

Most of the drift deposited in the Chicago area--and all the drift we have traveled over today--was deposited by Woodfordian glaciers during the period between 22,000 and 12,500 years before the present. These glaciers were the last to enter Illinois. Since all of them followed the same path through the trough that earlier glaciations had scoured through the basin of Lake Michigan, and since each tended to lap onto but not override the moraine of the preceding glacier, their moraines form close-spaced, roughly concentric loops around the end of the basin now occupied by Lake Michigan.

It should be noted that figure 1 is greatly simplified. The broad belt defined as the Valparaiso Morainic System consists, in places, of nine closely spaced moraines. Similarly, the Lake Border Morainic System consists of five moraines outside the map area.

The Valparaiso till section (see figure 3) is exposed on the south bank of Sawmill Creek a short distance below the falls. The exposure shows more than 40 feet of glacial drift--an unusually long section--and it includes good examples of till and outwash and a complete soil profile.

Silurian dolomites crop out in this valley, but north of the till section one has to be careful not to confuse the stone retaining walls along the creek with outcrops. According to an earlier geologic report, the top of the Silurian outcrop about 440 yards downstream from the till section bears grooves cut by stones frozen in the foot of a glacier. Such grooves reveal the direction of ice travel. Here the ice was moving from the northeast. Weathering appears to be obliterating the marks.

The Rocky Glen Forest Preserve has several other features of interest to students of natural sciences.

1. The Forest Protection District of Du Page County (which has a ranger in residence here and offices in Lombard at 881 West St. Charles Road) maintains a forest demonstration area and employs a county botanist who runs tours.

2. Sawmill Creek is polluted and runs a head of detergent foam.

3. There is a good rock collecting locality in an abandoned gravel pit in a kame one-half mile south of the park entrance (on the gravel road) and one-fourth mile east on a lane.

END OF TRIP

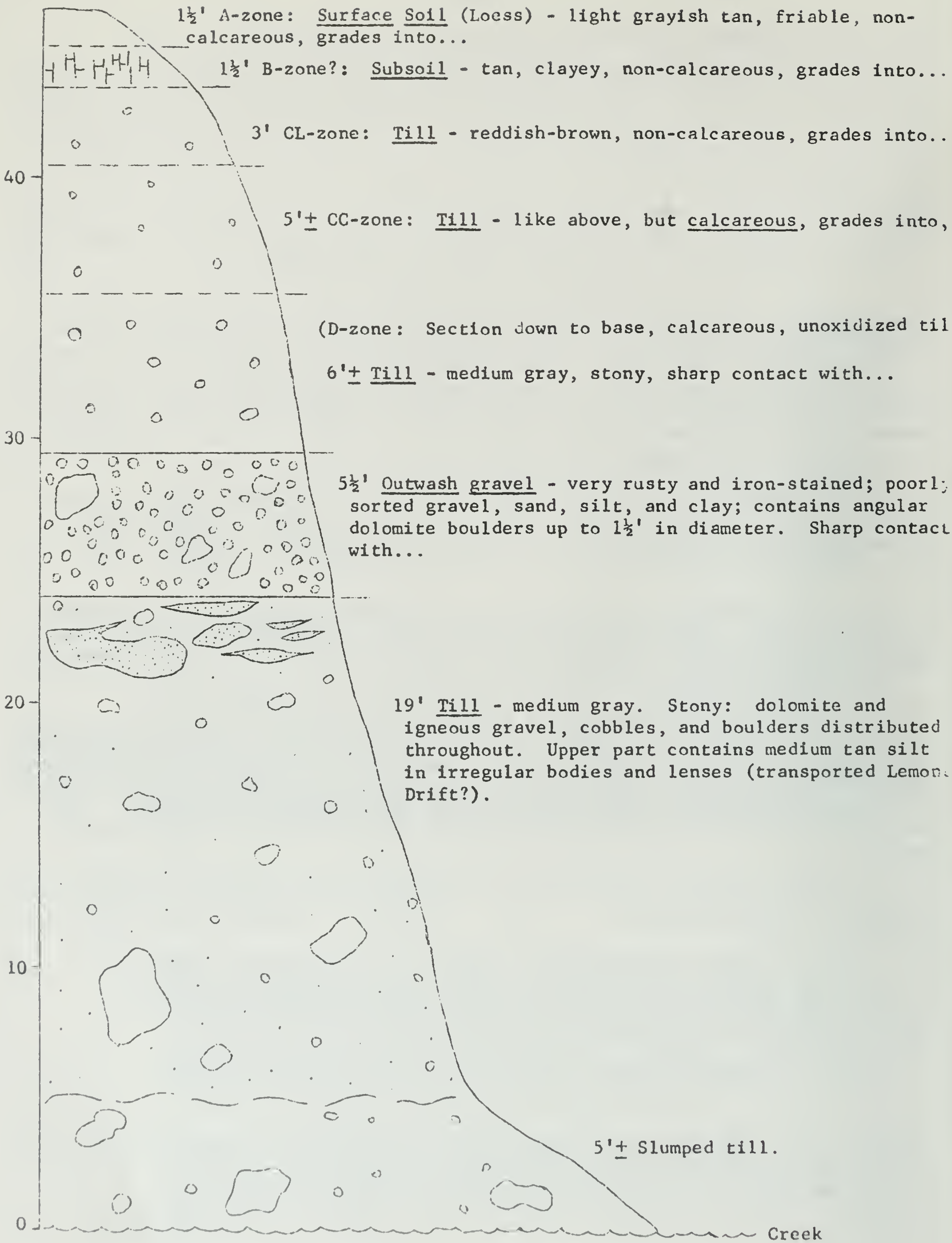


Fig. 3 - Valparaiso Till Section in Rocky Glen Forest Preserve.

EXPLANATION OF STOP 3: The rock name could be "land fill," "made land," or "cemented industrial sand." The material was dumped here to make a road bed, and its stratigraphic position, therefore, is above the modern, post-glacial (Holocene Stage) swamp deposits developed on top of Wisconsinan drift.

The inclusions of iron and coaly material may indicate that the sand came from a mill or foundry. A "tin" can embedded in it at the north end of the exposure is an artifact (or is it a "fossil"?--if so, why?) that also establishes the age of this outcrop as modern.

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PLEISTOCENE GLACIATIONS IN ILLINOIS

Origin of the Glaciers

During the past million years or so, the period of time called the Pleistocene Epoch, most of the northern hemisphere above the 50th parallel has been repeatedly covered by glacial ice. Ice sheets formed in sub-arctic regions four different times and spread outward until they covered the northern parts of Europe and North America. In North America the four glaciations, in order of occurrence from the oldest to the youngest, are called the Nebraskan, Kansan, Illinoian, and Wisconsinan Stages of the Pleistocene Epoch. The limits and times of the ice movement in Illinois are illustrated in the following pages by several figures.

The North American ice sheets developed during periods when the mean annual temperature was perhaps 4° to 7° C (7° to 13° F) cooler than it is now and winter snows did not completely melt during the summers. Because the cooler periods lasted tens of thousands of years, thick masses of snow and ice accumulated to form glaciers. As the ice thickened, the great weight of the ice and snow caused them to flow outward at their margins, often for hundreds of miles. As the ice sheets expanded, the areas in which snow accumulated probably also increased in extent.

Tongues of ice, called lobes, flowed southward from the Canadian centers near Hudson Bay and converged in the central lowland between the Appalachian and Rocky Mountains. There the glaciers made their farthest advances to the south. The sketch below shows several centers of flow, the general directions of flow from the centers, and the southern extent of glaciation. Because Illinois lies entirely in the central lowland, it has been invaded by glaciers from every center.

Effects of Glaciation

Pleistocene glaciers and the waters melting from them changed the landscapes they covered. The glaciers scraped and smeared the landforms they overrode, leveling and filling many of the minor valleys and even some of the larger ones. Moving ice carried colossal amounts of rock and earth, for much of what the glaciers wore off the ground was kneaded into the moving ice and carried along, often for hundreds of miles.

The continual floods released by melting ice entrenched new drainageways, deepened old ones, and then partly refilled both with sediments as great quantities of rock and earth were carried beyond the glacier fronts. According to some estimates, the amount of water drawn from the sea and changed into ice during a glaciation was probably enough to lower sea level more than 300 feet below present level. Consequently, the melting of a continental ice sheet provided a tremendous volume of water that eroded and transported sediments.

In most of Illinois, then, glacial and meltwater deposits buried the old rock-ribbed, low, hill-and-valley terrain and created the flatter landforms of our prairies. The mantle of soil material and the deposits of gravel, sand, and clay left by the glaciers over about 90 percent of the state have been of incalculable value to Illinois residents.

Glacial Deposits

The deposits of earth and rock materials moved by a glacier and deposited in the area once covered by the glacier are collectively called drift. Drift that is ice-laid is called till. Water-laid drift is called outwash.

Till is deposited when a glacier melts and the rock material it carries is dropped. Because this sediment is not moved much by water, a till is unsorted, containing particles of different sizes and compositions. It is also unstratified (unlayered). A till may contain materials ranging in size from microscopic clay particles to large boulders. Most tills in Illinois are pebbly clays with only a few boulders.

Tills may be deposited as end moraines, the arc-shaped ridges that pile up along the glacier edges where the flowing ice is melting as fast as it moves forward. Till also may be deposited as ground moraines, or till plains, which are gently undulating sheets deposited when the ice front melts back, or retreats. Deposits of till identify areas once covered by glaciers. Northeastern Illinois has many alternating ridges and plains, which are the succession of end moraines and till plains deposited by the Wisconsinan glacier.

Sorted and stratified sediment deposited by water melting from the glacier is called outwash. Outwash is bedded, or layered, because the flow of water that deposited it varied in gradient, volume, velocity, and direction. As a meltwater stream washes the rock materials along, it sorts them by size--the fine sands, silts, and clays are carried farther downstream than the coarser gravels and cobbles. Typical Pleistocene outwash in Illinois is in multilayered beds of clays, silts, sands, and gravels that look much like modern stream deposits.

Outwash deposits are found not only in the area covered by the ice field but sometimes far beyond it. Meltwater streams ran off the top of the glacier, in crevices in the ice, and under the ice. In some places, the cobble-gravel-sand filling of the bed of a stream that flowed in the ice is preserved as a sinuous ridge called an esker. Cone-shaped mounds of coarse outwash, called kames, were formed where meltwater plunged through crevasses in the ice or into ponds along the edge of the glacier.

The finest outwash sediments, the clays and silts, formed bedded deposits in the ponds and lakes that filled glacier-dammed stream valleys, the sags of the till plains, and some low, moraine-diked till plains. Meltwater streams that entered a lake quickly lost speed and almost immediately dropped the sands and gravels they carried, forming deltas at the edge of the lake. Very fine sand and silts were moved across the lake bottom by wind-generated currents, and the clays, which stayed in suspension longest, slowly settled out and accumulated with them.

Along the ice front, meltwater ran off in innumerable shifting and short-lived streams that laid down a broad, flat blanket of outwash that formed an outwash plain. Outwash was also carried away from the glacier in valleys cut by floods of meltwater. The Mississippi, Illinois, and Ohio Rivers occupy valleys that were major channels for meltwaters and were greatly widened and deepened during times of the greatest meltwater floods. When the floods waned, these valleys were partly filled with outwash far beyond the ice margins. Such outwash deposits, largely sand and gravel, are known as valley trains. Valley trains may be both extensive and thick deposits. For instance, the long valley train of the Mississippi Valley is locally as much as 200 feet thick.

Loess and Soils

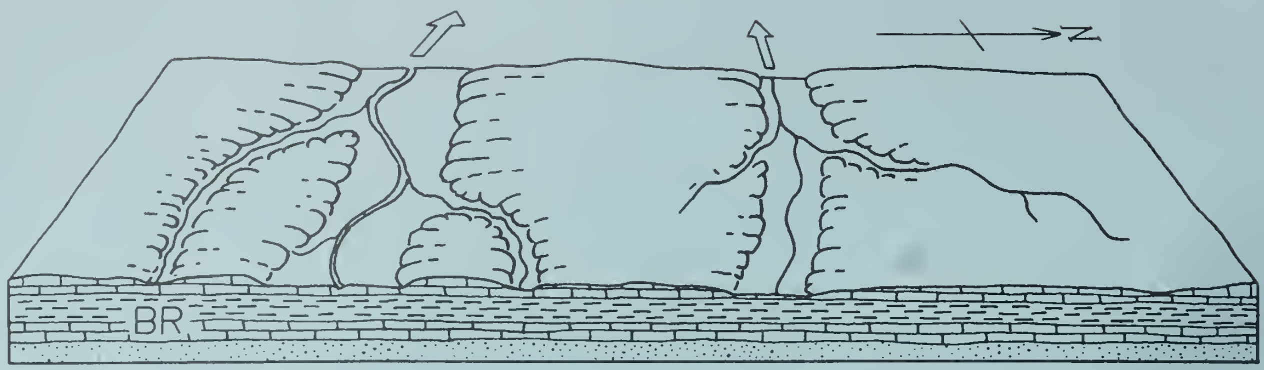
One of the most widespread sediments resulting from glaciation was carried not by ice or water but by wind. Loess is the name given to such deposits of windblown silt and clay. The silt was blown from the valley trains on the floodplains. Most loess deposition occurred in the fall and winter seasons when low temperatures caused meltwater floods to abate, exposing the surfaces of the valley trains and permitting them to dry out. During Pleistocene time, as now, west winds prevailed, and the loess deposits are thickest on the east sides of the source valleys. The loess thins rapidly away from the valleys but extends over almost all the state.

Each Pleistocene glaciation was followed by an interglacial stage that began when the climate warmed enough to melt the glaciers and their snowfields. During these warmer intervals, when the climate was similar to that of today, drift and loess surfaces were exposed to weather and the activities of living things. Consequently, over most of the glaciated terrain, soils developed on the Pleistocene deposits and altered their composition, color, and texture. Such soils were generally destroyed by later glacial advances, but those that survive serve as keys to the identity of the beds and are evidence of the passage of a long interval of time.

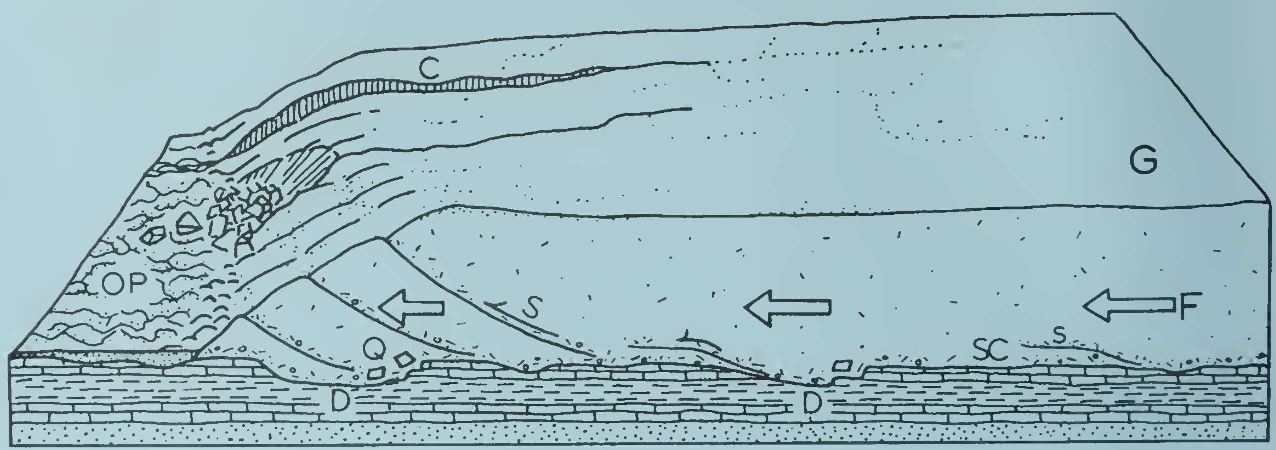
Glaciation in a Small Illinois Region

The following diagrams show how a continental ice sheet might have looked as it moved across a small region in Illinois. They illustrate how it could change the old terrain and create a landscape like the one we live on. To visualize how these glaciers looked, geologists study the landforms and materials left in the glaciated regions and also the present-day mountain glaciers and polar ice caps.

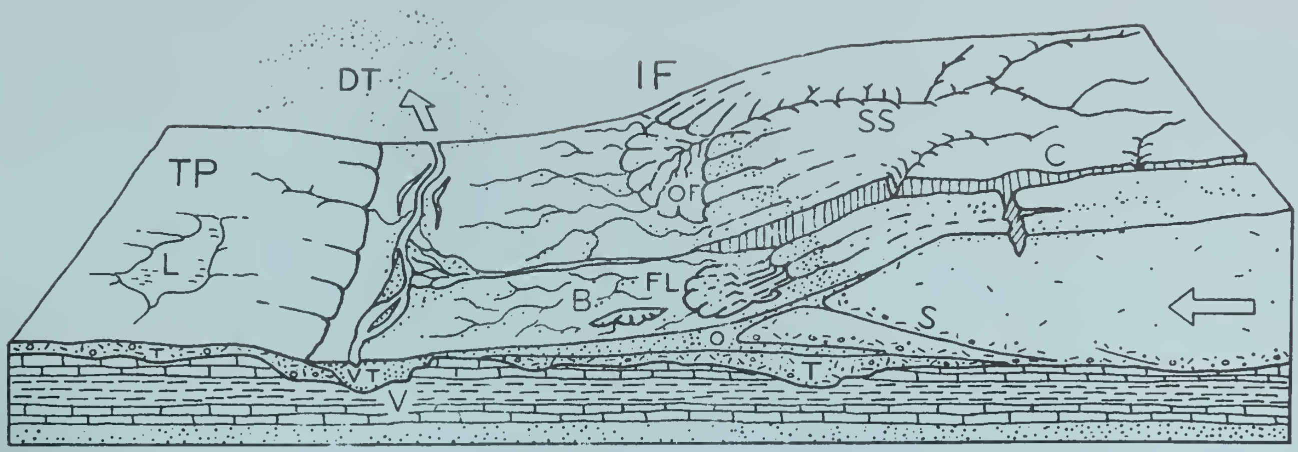
The block of land in the diagrams is several miles wide and about 10 miles long. The vertical scale is exaggerated--layers of material are drawn thicker and landforms higher than they ought to be so that they can be easily seen.



1. <u>The Region Before Glaciation</u> - Like most of Illinois, the region illustrated is underlain by almost flat-lying beds of sedimentary rocks--layers of sandstone ( ), limestone ( ), and shale ( ). Millions of years of erosion have planed down the bedrock (BR), creating a terrain of low uplands and shallow valleys. A residual soil weathered from local rock debris covers the area but is too thin to be shown in the drawing. The streams illustrated here flow westward and the one on the right flows into the other at a point beyond the diagram.



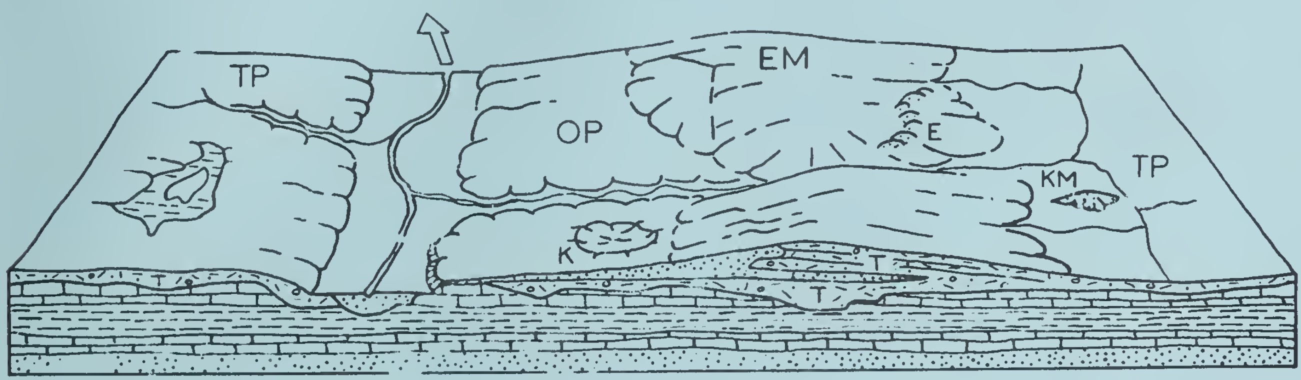
2. <u>The Glacier Advances Southward</u> - As the glacier (G) spreads out from its snowfield, it scours (SC) the soil and rock surface and quarries (Q)--pushes and plucks up--chunks of bedrock. These materials are mixed into the ice and make up the glacier's "load." Where roughnesses in the terrain slow or stop flow (F), the ice "current" slides up over the blocked ice on innumerable shear planes (S). Shearing mixes the load very thoroughly. As the glacier spreads, long cracks called "crevasses" (C) open parallel to the direction of ice flow. The glacier melts as it flows forward, and its meltwater erodes the terrain in front of the ice, deepening (D) some old valleys before the ice covers them. Meltwater washes away some of the load freed by melting and deposits it on the outwash plain (OP). The advancing glacier overrides its outwash and in places scours much of it up again. The glacier may be 5000 or so feet thick , except near its margin. Its ice front advances perhaps as much as a third of a mile per year.



3. <u>The Glacier Deposits an End Moraine</u> - After the glacier advanced across the area, the climate warmed and the ice began to melt as fast as it advanced. The ice front (IF) is now stationary, or fluctuating in a narrow area, and the glacier is depositing an end moraine.

As the top of the glacier melts, some of the sediment that was mixed in the ice accumulates on top of the glacier. Some is carried by meltwater onto the sloping ice front (IF) and out onto the plain beyond. Some of the debris slips down the ice front in a mudflow (FL). Meltwater runs through the ice in a crevasse (C). A superglacial stream (SS) drains the top of the ice, forming an outwash fan (OF). Moving ice has overridden an immobile part of the front on a shear plane (S). All but the top of a block of ice (B) is buried by outwash (O).

Sediment from the melted ice of the previous advance (figure 2) was left as a till layer (T), part of which forms the till plain (TP). A shallow, marshy lake (L) fills a low place in the plain. Although largely filled with drift, the valley (V) remained a low spot in the terrain. As soon as its ice cover melted, meltwater drained down the valley, cutting it deeper. Later, outwash partly refilled the valley--the outwash deposit is called a valley train (VT). Wind blows dust (DT) off the dry floodplain. The dust will form a loess deposit when it settles.



4. <u>The Region after Glaciation</u> - The climate has warmed even more, the whole ice sheet has melted, and the glaciation has ended. The end moraine (EM) is a low, broad ridge between the outwash plain (OP) and till plains (TP). Run-off from rains cuts stream valleys into its slopes. A stream goes through the end moraine along the channel cut by the meltwater that ran out of the crevasse in the glacier.

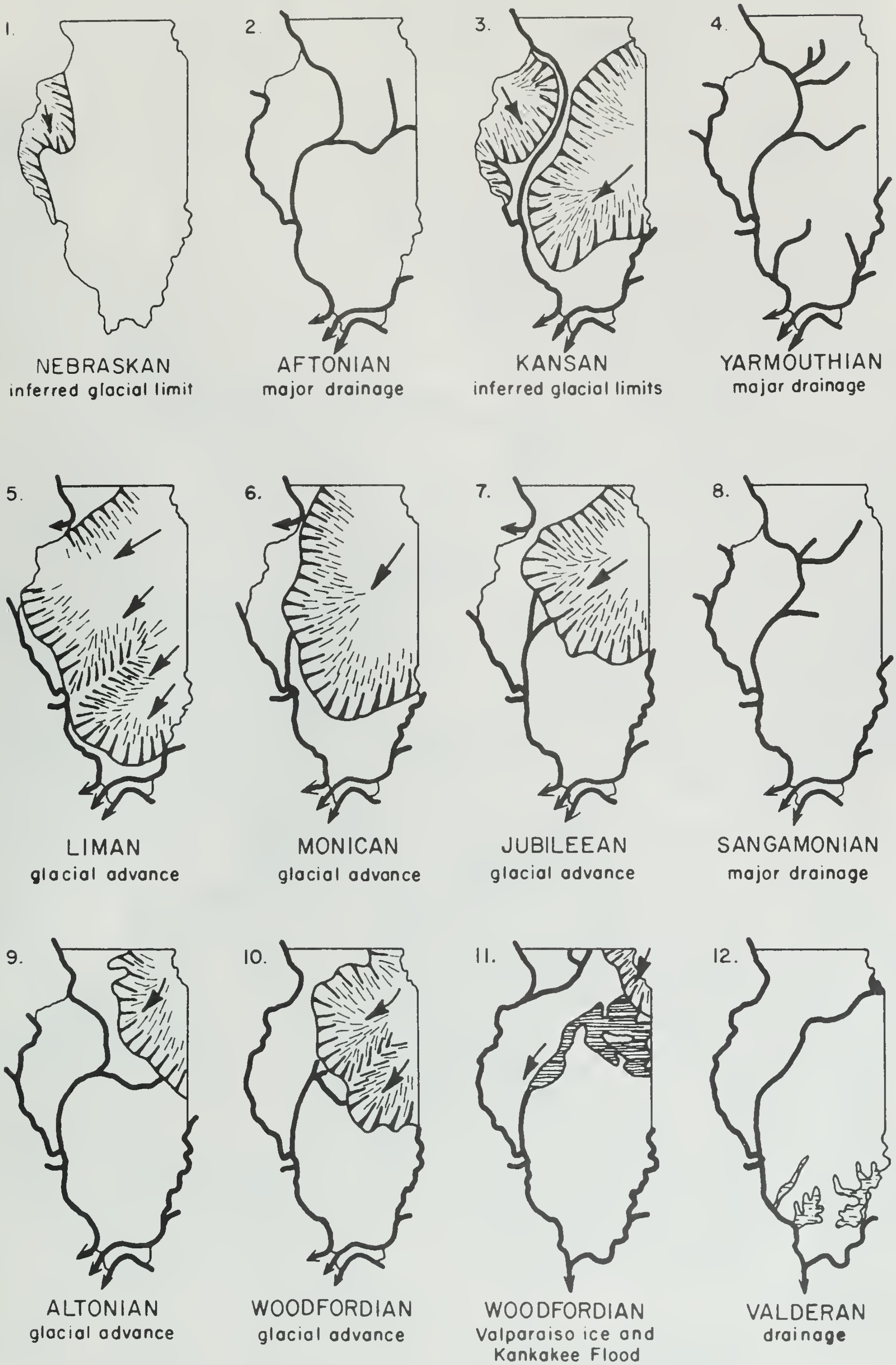
Slopewash and vegetation are filling the shallow lake. The collapse of outwash into the cavity left by the ice block's melting has made a kettle (K). The outwash that filled a tunnel draining under the glacier is preserved in an esker (E). The hill of outwash left where meltwater dumped sand and gravel into a crevasse or other depression in the glacier or at its edge is a kame (KM). A few feet of loess covers the entire area but cannot be shown at this scale.

TIME TABLE OF PLEISTOCENE GLACIATION

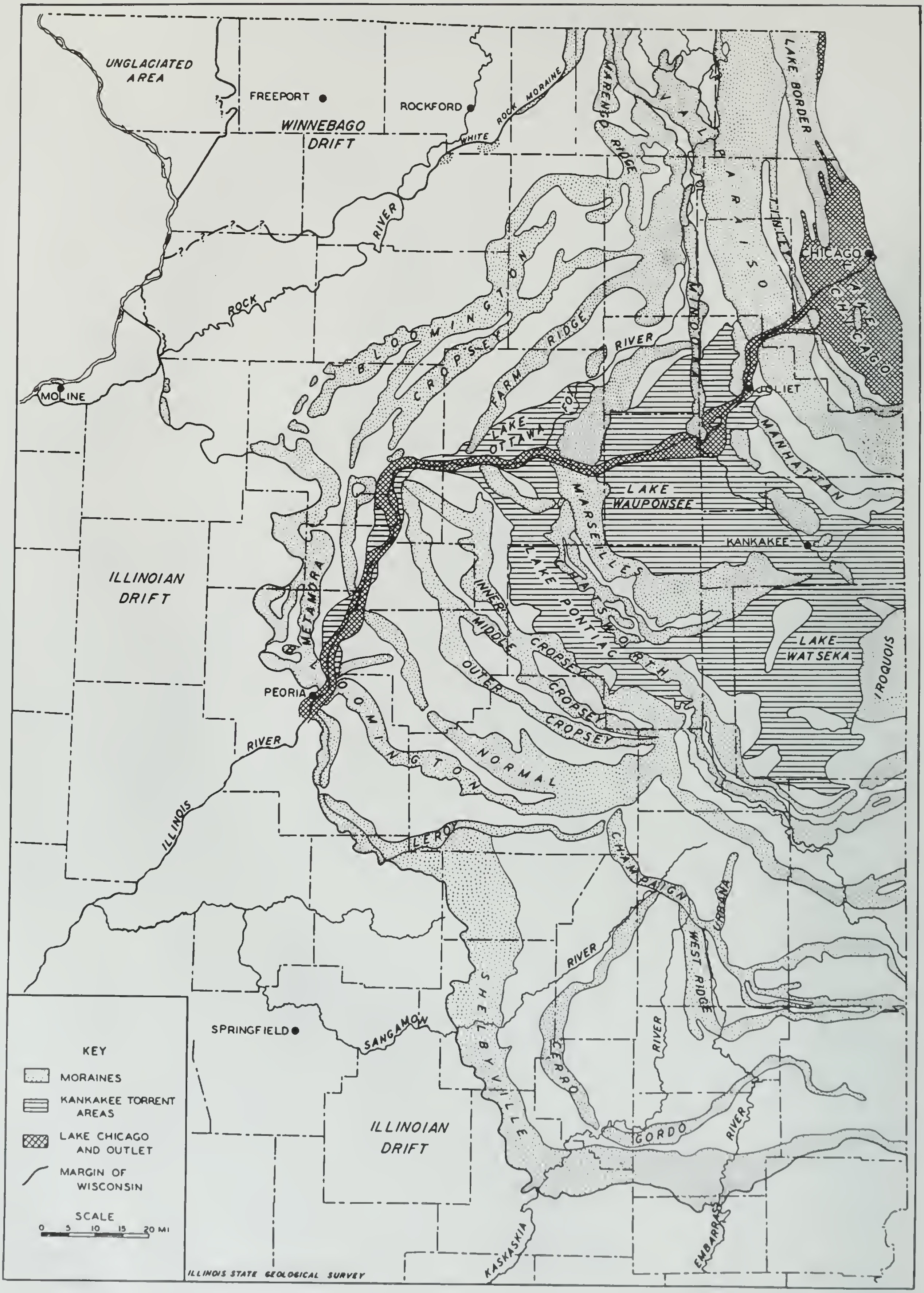
STAGE	SUBSTAGE	NATURE OF DEPOSITS	SPECIAL FEATURES
HOLOCENE	Years Before Present	Soil, youthful profile of weathering, lake and river deposits, dunes, peat	
	7,000		
WISCONSINAN (4th glacial)	Valderan	Outwash, lake deposits	Outwash along Mississippi Valley
	11,000		
	Twocreekan	Peat and alluvium	Ice withdrawal, erosion
	12,500		
	Woodfordian	Drift, loess, dunes, lake deposits	Glaciation; building of many moraines as far south as Shelbyville; extensive valley trains, outwash plains, and lakes
	22,000		
	Farmdalian	Soil, silt, and peat	Ice withdrawal, weathering, and erosion
	28,000		
	Altonian	Drift, loess	Glaciation in northern Illinois, valley trains along major rivers
	75,000		
SANGAMONIAN (3rd interglacial)		Soil, mature profile of weathering	
	175,000		
ILLINOIAN (3rd glacial)	Jubileean Monican Liman	Drift, loess Drift, loess Drift, loess	Glaciers from northeast at maximum reached Mississippi River and nearly to southern tip of Illinois
	300,000		
YARMOUTHIAN (2nd interglacial)		Soil, mature profile of weathering	
	600,000		
KANSAN (2nd glacial)		Drift, loess	Glaciers from northeast and northwest covered much of state
	700,000		
AFTONIAN (1st interglacial)		Soil, mature profile of weathering	
	900,000		
NEBRASKAN (1st glacial)		Drift	Glaciers from northwest invaded western Illinois
	1,200,000 or more		

(Illinois State Geological Survey, 1973)

SEQUENCE OF GLACIATIONS AND INTERGLACIAL DRAINAGE IN ILLINOIS



(From Willman and Frye, "Pleistocene Stratigraphy of Illinois," ISGS Bull. 94, fig. 5, 1970.)



GLACIAL MAP OF NORTHEASTERN ILLINOIS

George Ekblaw

Revised 1960

ILLINOIS STATE GEOLOGICAL SURVEY

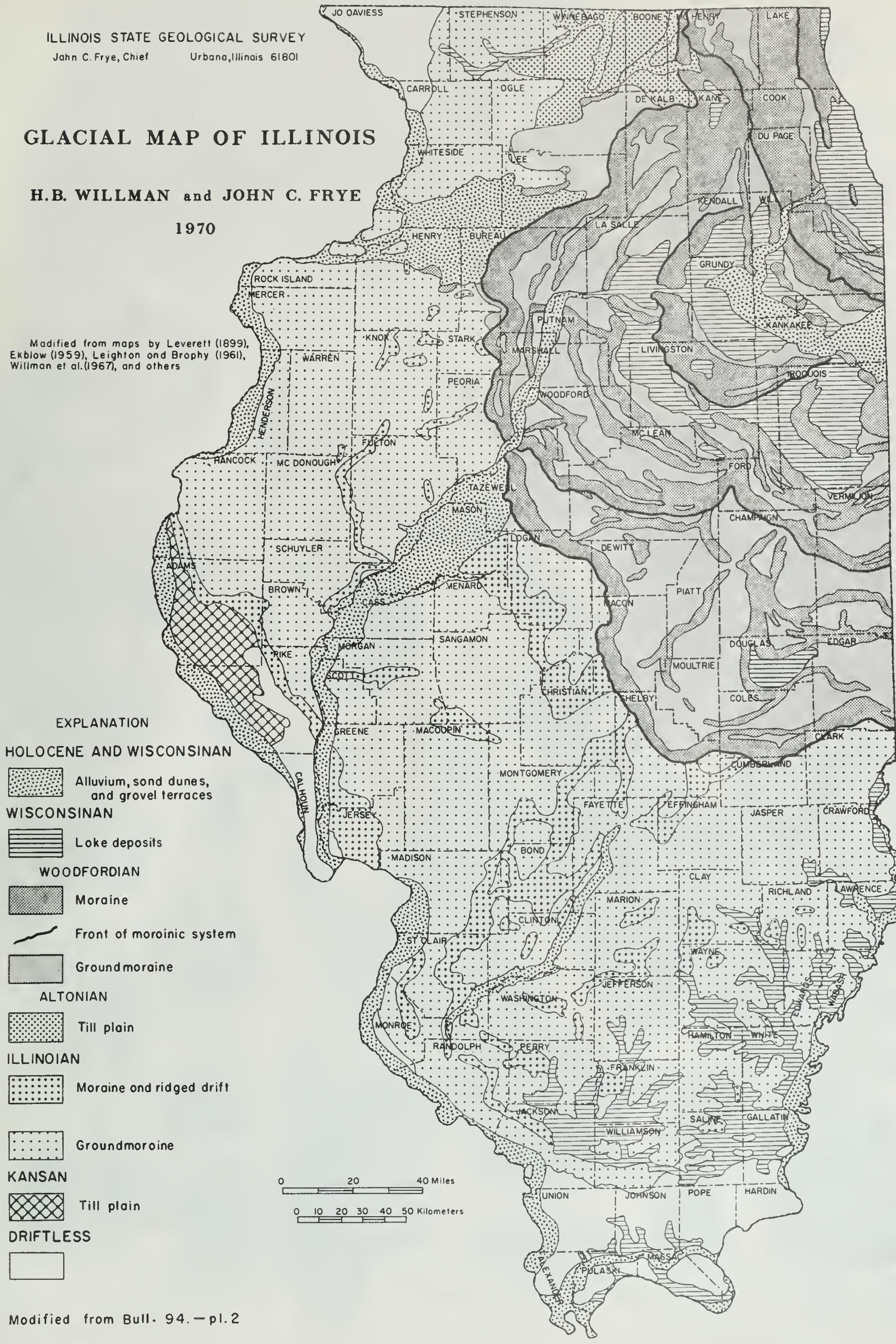
John C. Frye, Chief   Urbana, Illinois 61801

GLACIAL MAP OF ILLINOIS

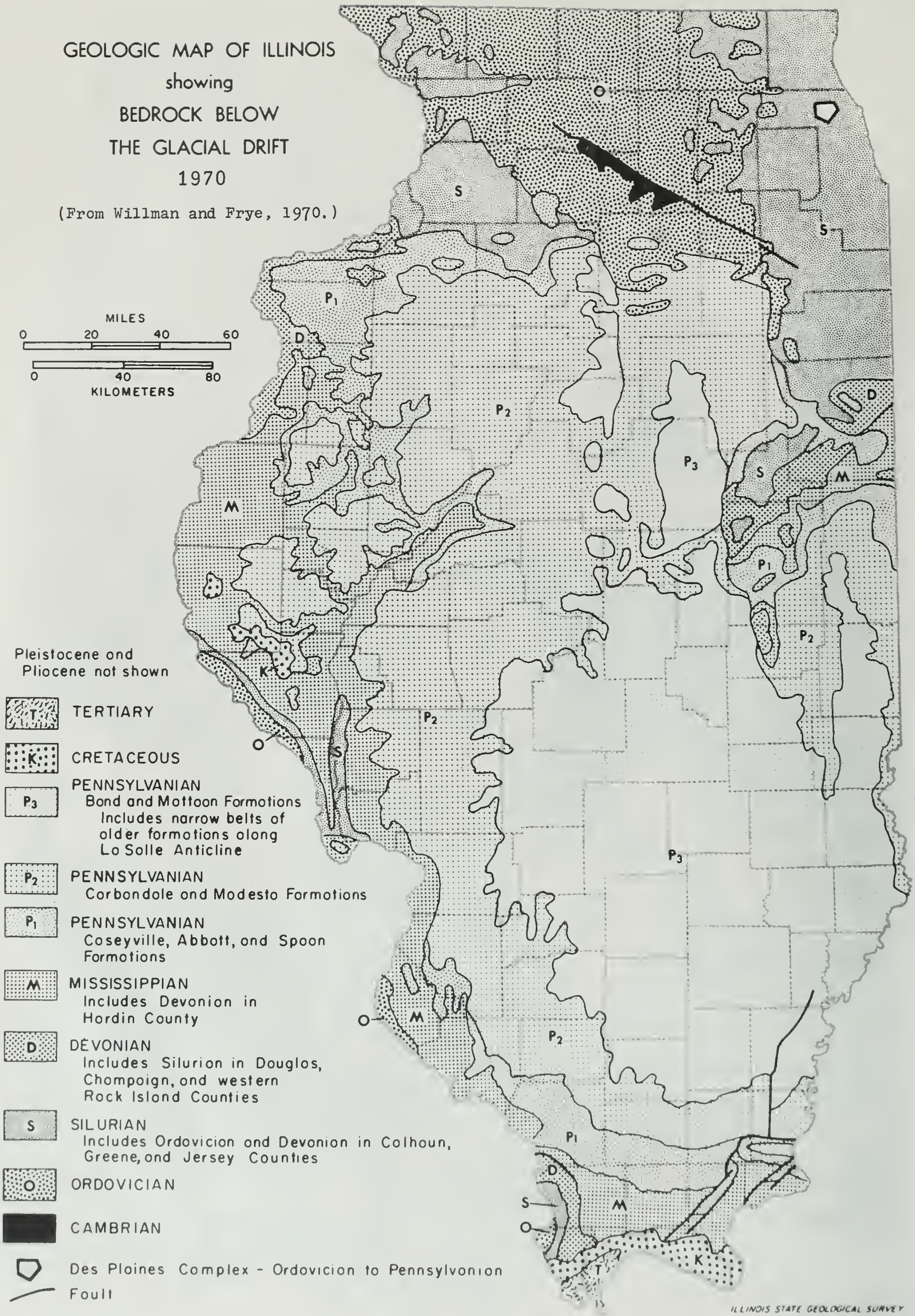
H.B. WILLMAN and JOHN C. FRYE

1970

Modified from maps by Leverett (1899), Ekblow (1959), Leighton and Brophy (1961), Willman et al.(1967), and others



Modified from Bull. 94.—pl.2


GEOLOGIC MAP OF ILLINOIS
showing
BEDROCK BELOW
THE GLACIAL DRIFT
1970
(From Willman and Frye, 1970.)
MILES
0 20 40 60
0 40 80
KILOMETERS
Pleistocene and
Pliocene not shown
T TERTIARY
K CRETACEOUS
P3 PENNSYLVANIAN
Bond and Mattoon Formations
Includes narrow belts of
older formations along
La Salle Anticline
P2 PENNSYLVANIAN
Carbondale and Modesto Formations
P1 PENNSYLVANIAN
Caseyville, Abbott, and Spoon
Formations
M MISSISSIPPIAN
Includes Devonian in
Hardin County
D DEVONIAN
Includes Silurian in Douglas,
Champaign, and western
Rock Island Counties
S SILURIAN
Includes Ordovician and Devonian in Calhoun,
Greene, and Jersey Counties
O ORDOVICIAN
CAMBRIAN
Des Plaines Complex - Ordovician to Pennsylvanian
Fault
O
S
P1
D
P2
P3
M
K
T
ILLINOIS STATE GEOLOGICAL SURVEY

REPRESENTATIVE SILURIAN FOSSILS FROM NORTHWESTERN ILLINOIS